of its former existence is preserved to us by means of impressions, molds or casts. On the other hand, certain shells preserved in the Pre-Pleistocene formations and which are not only practically unaltered but also have living representatives, are true fossils. The element of time as here applied to the definition may seem to certain biologists and geologists to be unessential. It is necessary, however, to have some term which may be applied to the "medals of creation" to set them apart from the realm of organisms which are living, or have lived within historic time.

Fossils may be briefly classified as follows:

A. Direct evidence.
1. Actual remains (spore cases; Oligocene ants, etc.).
   (*a*) Hard and soft parts preserved.
   (*b*) Hard parts only preserved.
   (*c*) Hard parts minus organic matter.
   (*d*) Hard parts plus mineral salts grading into:
2. Minute replacements (coal balls; labyrinthodont, teeth, etc.).
   Replacement molecule by molecule of the original organic matter by mineral salts, resulting in petrifaction which may or may not show structure. Results of metasomatic processes.
3. Coarse replacements (bulk of Palezoic fossils).
   (*a*) Molds of the exterior and interior.
   (*b*) Casts of the exterior and intermediate structures.
4. Prints (leaves; jelly fish, etc.). Plus or minus organic matter in the case of plants.

B. Indirect evidence.
1. Coprolites.
   (*a*) Whole or part of original substance.
   (*b*) Casts of original substance (coprolites of dinosaurs).
2. Artifacts (ant hills; prehistoric flints, etc.).
3. Tracks, trails or burrows (Arthrophycus; dinosaur tracks, etc.).

We may smile when the novelist uses the adjective, *fossil,* in a broad way; we may even argue with the petrologist, or physiographer when he uses the term to describe inorganic phenomena, but what are we to do when the paleontologist speaks of "fossil ripple-mark"? Clearly the word is rapidly becoming so used that it will soon be useless in a scientific sense. Since the paleontologist is more interested in fossils than the petrographer, geographer or even the "general" geologist, and since he alone has defined what fossils are, is it too much for him to ask his brother geologists to either adopt his definition or else to coin a new term which will better express the antiquity of inorganic structures. Perhaps it would be well for the paleontologists to set an example in the "good use" of the term, by using it correctly themselves. As they are also vitally interested in the geologic time-table, perhaps it would not be out of place for them to suggest that Paleozoic, Mesozoic, or Tertiary prefixed to "ripple-mark" or volcanoes would be much more descriptive and accurate than the adjective *fossil.*

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THE FIXATION OF ATMOSPHERIC NITROGEN

TO THE EDITOR OF SCIENCE: Allow me through the columns of SCIENCE to give publicity to a most unique experiment related to me by the late Dr. Paul Heroult, the inventor of the electric steel furnace, and simultaneously with Hall of the electrolytic process for the isolation of aluminum.

It serves to show in a simple but striking way the "fixation of atmospheric nitrogen" of which we have heard so much in the past four years.

Although described and shown to many scientific friends it was new to them all, and as it lends itself to lecture demonstration deserves to be better known.

The experiment consists in thoroughly mixing 90 grams of fine aluminum powder with 10 grams of lamp-black. This mixture is

poured on a tile or an iron plate making a cone. A piece of magnesium tape, about 5 centimeters long, has one end thrust into the top of the cone, the other end being bent down so that it is easily lighted by the flame of a match.

Contrary to expectation there is no violent puff or explosion, as with magnesium powder, but a steady progressive combustion, vivid and brilliant, emitting little smoke. When the whole has burned down there remains the most beautiful mass of crystals of aluminium nitride, Al_2N_2, mixed with some crystals of aluminium oxide.

The greater part of the air which took part in the combustion is thus solidified, only the small amount supporting the combustion of the carbon going off as gases.

When this nitride is heated with a solution of sodium hydrate ammonia gas is evolved.

When the ammonia is mixed with oxygen or air and passed through heated platinum gauze, nitric acid is produced.

When the ammonia and nitric acid are made to react on each other the valuable fertilizer ammonium nitrate results. When this ammonium nitrate is mixed with aluminium powder a very safe but powerful explosive, "Ammonal" is produced.

Thus we learn how intimately these chemical reactions are related in peace to fertilization, and in war to destruction. The experiment illustrates: Combustion in which the nitrogen of the air, as well as the oxygen acts as a supporter of combustion; the production of a crystalline nitride, Al_2N_2; synthesis of ammonia; synthesis of nitric acid; fixation of nitrogen to serve as fertilizer; fixation of nitrogen to serve as explosive. It would be unwise for us to conclude that explosives serve only in war. Far from it. Man's best and most serviceable feats in engineering have been made with the aid of these powerful agents. We should not forget how seven acres of rock under Hell Gate were blown to bits by one blast, and our harbor opened up to vessels of greater size.

Charles A. Doremus

CURRENT RESEARCH AND PUBLICATION IN THE AMERICAN MUSEUM[1]

In cooperation with the United States National Museum and other museums, North America from the Arctic to the Isthmus is now well covered by American Museum activities. Its work includes explorations, publications and photographic collections, relating to historic and prehistoric races of men, to the insects, fishes, amphibians, reptiles, birds and mammals, as well as to the extinct ancestors of these living groups. Especially noteworthy serial publications on recent explorations, completed or well advanced, are papers on the "Anthropology of the Southwest" with the Archer M. Huntington Fund, the "Bibliography of Fishes" with the Jesup Fund, continued by Professors Dean and Gudger, and six volumes on "Fossil Vertebrates" with the Jesup Fund. Aided by the Jesup Fund, Professor Osborn, as a member of the staff of the United States Geological Survey, has just completed his monograph, "Titanotheres of Western America," on which he has been engaged for nineteen and a half years.

About $75,000 has been expended since 1910 on South American exploration and publication through successive expeditions led by Chapman, Roosevelt, Cherrie, Miller and Richardson. The senior curator, Dr. J. A. Allen, has produced a series of standard papers on South American mammals. Expeditions into the interior bear the name of Theodore Roosevelt. Dr. Chapman's "Distribution of Bird-Life in Columbia," recently awarded the Daniel Giraud Elliot Medal by the National Academy of Sciences, is a classic and leads to similar volumes on the birds of Ecuador, of Peru and of Chile.

The Museum has thus far expended $190,000 on African exploration, research and publication. Unrivaled collections of reptiles, birds and mammals are in storage awaiting the construction of the African Hall, as the result of the untiring field work of a suc-

[1] Modified from the fifty-first annual report of the president, Henry Fairfield Osborn, May, 1920.